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and the Welsh Office

Health
Technical
Memorandum 82

FIRECODE

Alarm and Detection Systems

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Health Technical Memorandum 82

London
Her Majesty's Stationery Office

Firecode

FIRECODE brings together in one comprehensive suite of documents the Department's policy and technical guidance on fire precautions in hospitals and other NHS premises.

Basic policy, principles and key management guidance are contained in 'Firecode: Policy and Principles'. Other FIRECODE documents include the Health Technical Memoranda '80' series (which give technical guidance on various building, engineering and equipment issues), the Fire Practice Notes series (dealing with various specialist aspects of fire precautions) and Nucleus guidance. Existing HTMs will, in due course, be reissued in FIRECODE format. The suite includes 'Firecode: Directory of Fire Documents' which lists references to relevant legislation and relevant fire precautions guidance issued by non-DH sources (as, for example, the Home Office).

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Alarm and Detection Systems

FOREWORD

Health Technical Memorandum 82 was first published in 1982. This new edition revises and updates existing guidance and takes account of later changes to British Standards, and the advent of microprocessor based (addressable) fire detection and alarm systems.

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1. Introduction

Scope and Purpose

1.1 The provision of effective fire alarm systems in all hospitals is a vital component of the overall fire safety strategy which protects patients, staff and property from fire. This Technical Memorandum provides the general principles and technical guidance for those in the Health Service who have responsibility for the design, specification, installation, commissioning, testing, operation and maintenance of fire alarm systems in hospitals. It should be read in conjunction with BS 5839: Part 1: 1988 - Fire detection and alarm systems for buildings: Code of practice for system design, installation and servicing, and relevant FIRECODE guidance.

Application of Document

1.2 The guidance contained in this Memorandum applies to all premises covered by Health Technical Memorandum (HTM) 81 'Fire Precautions in New Hospitals' and Nucleus Fire Precautions Recommendations. It also applies to the renewal or upgrading of fire detection and alarm systems in existing hospitals. Full compliance will satisfy the requirements of the Home Office Draft Guide to Fire Precautions in Hospitals in respect of fire detection and alarms.

1.3 The guidance in this Memorandum is generally applicable to regional secure units and secure units within hospitals for the mentally ill or mentally handicapped, but does not cover any special fire alarm system requirements arising from security considerations in such units.

Relationship with British Standards

1.4 Fire alarm systems and system components for hospitals should comply with the relevant British Standards, as amended by this Memorandum.

1.5 The British Standards which are relevant to fire detection and alarm systems are listed in 'FIRECODE Directory of Fire Documents'.★ These Standards deal with systems generally rather than with their application specifically to hospitals, and some items are not appropriate to hospitals. This Memorandum must be read in conjunction with BS 5839 and other relevant British Standards. It complements the British Standards by amplifying specific aspects and providing, where necessary, recommendations which replace British Standard clauses with ones appropriate to the particular needs of hospitals. Clauses not specifically mentioned apply in full. References made to British Standard clauses indicate that:-

the BS clause is either not applicable or only partly applicable to hospitals and the appropriate guidance is contained in this Memorandum; or

the BS allows the selection of options; the option applicable to hospitals is given in this Memorandum.

Function of Fire Alarms in Hospitals

BS 5839 Part 1 Para 9.10

1.6 The function of fire alarms in hospitals is to give warning to staff in the event of fire so that an early call to the fire brigade, first aid fire-fighting and evacuation may be carried out. Unlike most other types of buildings, in hospitals it may not be necessary or even desirable to give warning to all the occupants.

BS 5839 Part 1: Appendix H

1.7 The use of smoke alarms (self-contained or single-stage fire detectors) is sometimes proposed for hospitals on the grounds of cheapness. However, these devices are designed primarily for use in domestic dwellings. They do not provide the full facilities required in hospitals for alerting staff and initiating automatic calls to the fire brigade after a fire is detected, whether automatically or by persons. A smoke alarm unit automatically emits only a local alarm from within the device in the event of smoke being detected.

1.8 Whilst it may be technically feasible by interconnecting a number of smoke alarm units and adding other equipment such as manual call points to form a rudimentary fire alarm system, such an arrangement could never be as satisfactory or reliable as a proper fire detection and alarm system. The simple system would most likely entail higher maintenance costs with time.

★Also listed in 'DHSS Register of Departmental and Advisory Documents' which contains details of British Standards related to fire and which is updated three times a year (available from Industrial Communication Consultants, 21 Montpelier Row, London SE3 ORR).

1.9 Consequently, smoke alarms are not recommended as a form of permanent installation within hospitals, although they may have a limited application, for example in a staffed area which may be temporarily without cover from main system detectors. Their particular limitations must always be borne in mind.

Exchange of Information and Planning

BS 5839 Part 1 Para 4 and Para 5

1.10 The effectiveness of a fire alarm system is only as good as the total fire precautions system of which it forms part, and the designer of the fire alarm system should work in close liaison with those concerned with planning and administration of fire precautions, eg managers, works officers, doctors, nurses, and fire officers. In particular, it is desirable that the responsible person as defined by BS 5839 Part 1 should be included in this liaison. Appendix 1 of this HTM is an aide-memoire of items which will affect the design.

BS 5839 Part 1 Para 4.1

1.11 There will usually be a number of interested parties involved in any project including consultant designer, main contractor and fire alarm and electrical sub contractors. Their contracts must be compatible and clearly specify their individual responsibilities. It is important that one organisation should have overall responsibility for the performance of the system. See also paragraphs 12.4 and 12.5. Problems have frequently arisen in the past where a fire alarm and detection system has been built up on site from components not previously proven to work in combination. Attention is drawn to BS 5839 Part 1, para 6.7.

BS 5839 Part 1 Para 5

1.12 In the course of the life of premises and their automatic fire detection system, the usage put to parts of the premises may change. It is necessary to ensure that any such changes are not in conflict with the intentions of the original fire detection scheme. If necessary, changes should be made to the fire detection scheme to maintain its effectiveness.

Certification of Products and Services

BS 5839 Part 1 Para 6.8

1.13 In selecting firms for design, manufacture or installation, it is recommended that preference is given to firms certified to the appropriate part of the quality systems standard BS 5750.

1.14 Fire protection equipment which carries BAFE approval (see footnote) will have been independently tested for conformity against a relevant product standard, and the supplier's quality system will meet a relevant quality standard. BAFE approved equipment, and BAFE approved installation and maintenance organisations, should be used where possible, ie where a sufficient choice of appropriate approved products or organisations exists. Currently (October 1988) BAFE approval was largely restricted to certain types of fire fighting equipment and fire extinguisher maintenance, although its extension into the fire detection and alarm field is anticipated.

Footnote

The British Approvals for Fire Equipment (BAFE) is a national approvals body set up to promote the use of certified fire protection equipment, installation and maintenance services. BAFE adopts as National Schemes those run by certification bodies accredited by the National Accreditation Council for Certification Bodies and owns and controls quality markings for use in conjunction with such schemes.

2. General Design Considerations

General

BS 5839 Part 1 Para 4

2.1 There are a number of factors which will be fundamental to the design of the fire alarm system and to the ultimate efficiency and effectiveness of the installation. Paragraphs 2.2 to 2.10 describe some aspects which the planning team should consider before detailed design of the system is commenced.

Type of System

BS 5839 Part 1 Para 3 and Para 6.1

2.2 It is essential at the outset to establish the principal purpose which the particular fire alarm system is required to fulfil (eg life (L) or property (P) protection). Different parts of the hospital may require different types of system.

Provision and Location of Fire Alarm Panels

2.3 The provision and location of fire alarm panels should take into account the needs of the users, who will generally be those responsible for taking the preplanned action in the event of an alarm, and members of the fire brigade.

2.4 All controls and indicators, provided to enable the system to be used effectively in the event of an alarm, should be sited in a location which is manned 24 hours each day, typically a telephone switchboard or continuously manned reception. Where this is impracticable the panel should be mounted where there is maximum supervision and a procedure developed to ensure that the panel is attended immediately the alarm has been raised.

Fire Zones

BS 5839 Part 1 Para 7

2.5 Each building (except very small buildings) should be divided into fire alarm zones in accordance with the principles of BS 5839 Part 1. Additionally, where in a hospital, fire compartments are divided into 'sub-compartments' (see HTM81 chapter 9), or in hospitals divided into 'protected areas' (see the Home Office Draft Guide to Fire Precautions in Hospitals), a zone should not extend beyond a single sub-compartment or protected area.

Note: In large hospitals it is often convenient to group a number of zones together to form sectors (see BS 5839 Part 1 paras 2.15 and 7.2 (h)).

Fire Alarm Warnings

2.6 The fire warning system should be designed to be an integral part of the hospital evacuation strategy and to minimise distress and disturbance to patients and staff. The alarm should be given automatically in those zones at risk or where there is a need to alert staff. The correct automatic alarm responses (eg evacuate, alert, staff alarm) for each alarm initiation point should be established (see paragraph 4.3).

2.7 It may be advisable to supplement the normal audible/visual warnings with additional messages, either textual or audible, around the site. Such additional information can enhance staff response to an alarm and may be a necessity in larger sites and large or tall buildings. If an intercommunication or public address system is used it should meet the requirements of BS 5839 Part 1 para 9.12

Actuation of Other Fire Safety Systems

2.8 The fire alarm system may be required to actuate other systems. These may include:-

a. door control systems;
b. fixed extinguishing systems;
c. site signalling systems;
d. other fire alarm systems;
e. ventilation and damper control systems

System Technology

2.9 Addressable systems; modern fire alarm systems are making increasing use of microprocessors, and such systems have been given various descriptions, viz 'addressable', 'intelligent', 'software controlled' and 'smart'. The common feature of all these systems is that they are 'addressable'. For the purposes of this HTM, fire alarm systems are classified as either 'conventional' (ie non-addressable) or 'addressable'. In this respect the term 'addressable system' is as defined in BS 5839 Part 1 para 2.1

2.10 Addressable systems (see Appendix 2) should be specified for hospitals, unless there are special reasons to the contrary. Such systems will be best able to satisfy the requirements of this HTM for an efficient, effective and reliable installation. The facilities and refinements afforded by systems from

different suppliers vary, and the design team will need to decide which facilities offer significant benefit in their particular application (see also paragraph 6.21). This decision must not only have regard to the suitability of the system for the purpose, but should also be influenced by cost considerations including installation and maintenance costs, as well as the capital cost of the system.

2.11 Consideration should be given to the relationship of the fire alarm system to other services. For example, it may be an advantage to display fire alarm information along with building management or security information on a common visual display unit (VDU) or printer (although a separate primary annunciating panel for the fire alarm system should still be supplied). Where fire alarm outputs are monitored by other services, it should be ensured that operation of the monitoring services, or any service connected thereto, or any faults on those services, cannot affect the operation of the fire alarm system.

2.12 Any areas requiring waterproof, flameproof or intrinsically safe equipment should be identified.

3. Communication with the Fire Brigade

BS 5839 Part 1 Para 8

3.1 The following paragraphs give specific recommendations for providing communication between hospitals and the fire brigade. Supporting information is given in Appendix 3 which briefly describes the principal automatic methods of communication, and lists their respective advantages and disadvantages. The relevant recommendations of BS 5839 Part 1 should also be followed.

3.2 It is essential that reliable means are established for ensuring that, when an alarm of fire occurs, the fire brigade is summoned with the minimum of delay. Written fire procedures should clearly and unambiguously define responsibilities for summoning the brigade when a fire is discovered and/or an alarm of fire is raised.

3.3 At the planning stage the means available for communicating with the fire brigade should be investigated eg '999' service, direct telephone link, direct or indirect automatic links.

The Principles of Communication applying to Hospitals

Note: The recommendations in this HTM assume that fire at a hospital would pose a serious threat to the occupants, many of whom would be non-ambulant. The recommendations would probably be considered as excessive where property protection was the sole issue.

3.4 The principles for communicating are:

3.4.1 A designated person at the hospital premises will normally summon the fire brigade by voice communication using either the 999 emergency system or by a direct telephone link. For the purposes of this HTM this is defined as the Primary Method.

3.4.2 In order to allow for possible failures of the primary method an alternative method should normally be provided. This is defined as the Secondary Method.

3.4.3 Where a method of direct automatic transmission to the fire brigade is available, this should generally be used as the secondary method of communication.

3.4.4 Where the primary method of communication can be considered as having high reliability the secondary method of communication may not be necessary (see 3.6).

3.4.5 Where the primary method of communication is not of high reliability (see 3.5) the secondary method should be by either direct (preferably) or indirect automatic means (see Appendix 3).

Primary Methods of Communication and Responsibilities

3.5 The responsibility for summoning the brigade should lie with one of the following persons, listed in descending order of preference:-

a. A designated person, such as a switchboard operator or receptionist, at a continuously manned location, such as a telephone switchboard, reception or porter's lodge, at which is located the main fire alarm control and indicating equipment, repeat indicating equipment or an alarm sounder that operates whenever a fire alarm signal is initiated. The sounder should be connected to a monitored circuit that is intended for sounders.

b. A designated person, such as sister-in-charge or porter, who will always have ready access to a telephone and will, at any time, be able to hear the fire alarm signal, regardless of the source of the alarm or the person's location within the hospital.

c. The person who discovers the fire.

NOTE This will only be applicable to small premises with few staff. In all other premises the person discovering a fire should first raise the alarm to alert other occupants, one of whom should be the designated person of (a) or (b) above. The person who discovers the fire is then in a position to perform other duties, such as moving patients to a place of safety or attempting to fight the fire.

3.6 A high reliability primary method for the purposes of 3.4.4 is one which conforms to 3.5(a) and where the following conditions must also be satisfied.

i. The location in question should be continuously manned on a twenty-four hour basis by at least two designated persons with immediate access to an outgoing line (often a telephone switchboard).

ii. The possible effects of fire on the responsible persons and/or the telephone equipment should be considered.

iii. The possibility of incoming telephone calls preventing access to an available telephone line should be considered.

iv. If the situations described in ii. or iii. could give rise to any delay in summoning the brigade, a dedicated 'incoming calls barred' exchange line for use in emergencies only should be provided. Or, subject to the agreement of the fire brigade, a direct speech circuit should be installed between the premises and the fire control.

Contacting the Fire Brigade

3.7 The designated person will normally use the 999 system to summon the fire brigade, and this is an acceptable arrangement. However, consideration should be given to the availability of a suitable telephone line at all times of day or night. Communication with the brigade is sometimes possible by means of a direct speech line between the hospital and a fire control or fire station (a 'fire telephone'), thereby obviating the short delay involved in use of the 999 system. However, few brigades will permit such a facility and, unless the hospital and the fire control are in relatively close proximity (eg not more than a few miles apart), the rental charge for the speech circuit is likely to prove prohibitive.

3.8 In most cases, 999 calls will be routed through the British Telecom (BT) Public Switched Telephone Network (PSTN). If 999 calls are to be routed through the networks of other Public Telecommunications Operators (PTO) it should be ensured that in every case the PTO can offer the same reliability of call handling service as may be available from the BT PSTN.

3.9 It should be ensured that there is a formal agreement between the PTO and the appropriate fire service to receive that PTO's calls. There should be at least two alternative routes by which the PTO can connect 999 callers to the fire service. This may for example comprise two separate PSTN telephone numbers preferably connected through different telephone exchanges.

Fire Procedures

3.10 It is important that:

i. the fire procedure caters for all times of day and night. For example, in a large hospital, para 3.5(a) may apply at all times. In a smaller hospital, (a) may apply during the day, and (b) or (c) would then apply at night.

ii. the designated persons are aware of their responsibilities and have clear written instructions to summon the brigade as soon as the alarm sounds or a fire is reported to them.

iii. the designated persons do not rely on any third party or automatic alarm transmission system to summon the brigade.

iv. the summoning of the brigade by any third party or automatic alarm transmission system is regarded as a secondary ('back up') arrangement (see below).

Secondary Methods of Communication

3.11 The primary method of communication described above, should always be supported by a secondary method except in the case of 3.4.4. This will normally result in two calls to the fire brigade.

3.12 Where the primary method is as described in 3.5(a), the secondary method may be as described in 3.5(b), or may be automatic. All other primary methods should be supplemented by automatic secondary methods.

3.13 There are three types of automatic secondary method of communication with the fire brigade:-

a. Automatic transmission direct to the brigade (see paragraphs 3.14 and 3.15).

b. Automatic transmission of a signal to a remote manned centre, from which the brigade will be summoned. (See Appendix 3).

c. Auto-diallers, which automatically relay a taped speech message to the brigade via the 999 system. (See Appendix 3). In view of the significant disadvantages of this method of transmission, auto-diallers are not generally recommended (but see Appendix 3A).

Automatic Transmission Direct to Brigade

3.14 Ideally, the fire alarm system would automatically relay fire alarm signals direct to the relevant fire brigade control. Facilities of this type obviate even the short delay involved in the use of the 999 system. Such facilities are available in only very limited areas of the country, but involve transmission of signals over one of the transmission paths defined below:-

a. direct lines between the hospital and the fire control;

b. direct lines between the hospital and a fire station, from which the signal is automatically transmitted onward to fire control via the brigade communications network;

c. the British Telecommunications Plc 'Alarms by Carrier' (ABC) signalling system.

3.15 Advantages and disadvantages of the various direct automatic methods are summarised in Table A3(1) of Appendix 3. However, it is unlikely in practice

that more than one of the methods will be available in any given area. In most areas none will be available.

NOTE Due to their high reliability where any of these direct automatic methods are available to a hospital serious consideration should be given to their use irrespective of whether a secondary method of communication is required by 3.11.

Communication via Remote Manned Centres

3.16 The most common form of secondary communication will be one that involves the automatic transmission of signals to a remote manned centre. There are two categories of remote manned centre to which alarm signals may be transmitted:-

a. NHS premises, such as an ambulance control centre or the telephone switchboard of a remote hospital;

b. commercially operated alarm monitoring centres ('central stations').

3.17 Any central station responsible for monitoring fire alarms should comply with a recognised standard, such as that produced by the Loss Prevention Certification Board (LPCB), in respect of its construction, power supplies, operating practices, etc. Central stations independently certified by an approvals body, such as the LPCB, are preferred. It should be a condition of the contract with the alarm company which provides alarm monitoring services at a central station that the arrangements made are capable of relaying calls to the fire brigade within 60 seconds of the alarm being operated at the protected premises.

3.18 The use of central NHS facilities for alarm monitoring obviates the service charges levied by alarm companies and enables health authorities to maintain control over standards of efficiency. It must be ensured, however, that such standards are equivalent to those relevant standards offered by, and imposed on, the central stations of reputable alarm companies.

3.19 Ambulance controls are recommended for consideration as remote alarm monitoring centres as the Ambulance Service is an integral part of the NHS. Moreover, ambulance control staff are well trained in the handling of emergency calls. Any arrangements to use ambulance controls to pass on calls should have the agreement of the Chief Fire Officer of the relevant brigade.

Transmission of Alarms to Remote Manned Centres

3.20 Methods by which fire alarm signals may be transmitted from a hospital to a remote manned centre are summarised in Appendix 3.

3.21 With the exception of digital communicators, any method shown in Appendix 3 Table A3(2) is generally acceptable as a secondary method of communication with the brigade.

3.22 The Public Switched Telephone Network (PSTN) is not specifically designed for the transmission of fire alarm signals. Accordingly, digital communicators are not generally recommended in situations where life safety is involved (but see Appendix 3A).

Communication between Remote Manned Centres and Fire Brigades

3.23 The selected remote manned centre should be provided with two independent means of speech communication with the fire brigade. The following methods of communication, listed in descending order of preference, are those considered to be acceptable:-

a. A private wire between the remote manned centre and the fire brigade control room.

b. An ex-directory telephone number that can be used to establish direct communication with the fire brigade control room, in which an incoming call on that number is unambiguously identified as an emergency call.

NOTE: A single number that gives access to a 'hunting group' of two lines or more will satisfy the requirement for two independent means of speech communication.

c. Use of the 999 system via a telephone exchange that will, as normal practice, route the call to the appropriate fire brigade control.

3.24 The means of communication between the remote manned centre and the fire brigade should be agreed with the Chief Fire Officer of the relevant brigade.

4. Alarms

Audible Alarms

BS 5839 Part 1 Para 9

4.1 The general policy on fire safety in the NHS presupposes that the staff, not the patients, are the people who need to be alerted when the fire alarm operates, because the staff are responsible for taking the initial action in fighting the fire and in moving patients away to a place of safety. It is essential that all staff who are required to perform fire safety duties are alerted immediately.

4.2 It is undesirable to have patients disturbed by loud noise when the fire alarm operates because:-

a. some may be critically ill and may be affected by the noise;

b. due to their medical state or treatment the inability to escape may cause confusion and panic.

It has been argued that a loud noise with the consequential risk to a patient's health is justified under a fire condition. However this argument does not apply when the sounders are being tested.

BS 5839 Part 1 Para 9.9

4.3 In hospitals having more than one zone, a two stage alarm should be provided giving a continuous signal in the zone of the fire and initially only an intermittent signal in those other zones where staff need to be alerted as part of fire safety procedures.

4.4 Frequently the sounders in one fire alarm zone can be heard in another, and it is, therefore, important that in the two-stage alarm system the 'alert' signal in one zone (intermittent note) cannot confuse the 'evacuate' signal (continuous note) in the zone of the fire. In practice this confusion has been found to occur when warblers have been used for 'alert' signals instead of distinct pulses. Hence the use of warblers is not recommended. Also, care should be taken where bells are used that any 'over-run' ringing of the bell does not cause the intermittent note to sound continuously.

4.5 Consideration should be given to the use of electronic sounders in preference to bells. Electronic sounders having an adjustable sound output facilitate the ability to achieve suitable fire alarm sound levels and their use is recommended.

BS 5839 Part 1 Para 9.4

4.6 The audible alarm system in patient areas should be designed as a staff warning system. Appendix 4 gives acoustic recommendations for fire alarm warnings in patient areas. An audible warning system designed in accordance with these recommendations will be clearly audible throughout the patient area and, whilst patients will be aware of the alarm signal, it will not be unnecessarily loud and should not cause undue distress.

BS 5839 Part 1 Para 9.10

4.7 An audible alarm system in patient areas which meets the minimum sound level requirements of Appendix 4 will suffice as the general fire alarm in these areas, provided it meets the other requirements of BS 5839 Part 1 for fire alarm sounders. Where the staff alarm system is restricted to sounders and other forms of communication not meeting the minimum sound level recommendations of Appendix 4, facilities for giving a general alarm should be separately provided.

4.8 The fire alarm sound level should be assessed with the building fully occupied and in use to ensure that the fire alarm is clearly audible during normal operation. It is not always possible to predict with accuracy at the design stage the ambient noise that will result in normal use. Spare capacity should be provided in the design to allow for the later addition of sounders. The use of sounders having adjustable sound output may enable the acoustic criteria to be achieved without recourse to changing or resiting sounders which may prove costly.

4.9 The mounting height of sounders is important. Sound may be attenuated if sounders are mounted nearer than 600mm below the ceiling.

BS 5839 Part 1 Para 8.3

4.10 If communication with the fire brigade is by means of telephones connected through electronic exchanges which have dual-tone multi-frequency (DTMF) dialling, it is necessary to ensure that sounders cannot interfere with the successful establishment of alarm calls. This potential problem has been identified in para 8.3 of BS 5839 Part 1.

4.11 Extension telephones in hospitals are frequently used for emergencies such as contacting cardiac arrest teams and instances of interference with fire alarm calls have been reported. Any telephone

using DTMF dialling which may be used for emergency purposes should be checked for interference by attempting to dial a call during the operation of a sounder, whether it is of a tone type or bell.

4.12 When interference is present it may in some cases be permissible to reduce the sound level with the agreement of the local fire officer. However, the resultant level must comply with the requirements set by para 9.4 of BS 5839 Part 1 (see also Appendix 4 of this HTM). Alternatively or additionally, the telephone instrument may be relocated or changed to a type providing 'on-hook' dialling. These procedures may need to be repeated if changes are made to the fire alarm system, telephone system or location of telephone instruments.

Visual Alarms

BS 5839 Part 1 Para 9.7

4.13 In addition to any visual alarms required in accordance with the British Standard recommendations, visual alarms (generally flashing light units) should be provided in areas where normal alarm sounders are unacceptable. Among such areas are operating theatres, ITU's, treatment rooms and animal houses. It may be necessary to supplement the flashing light with a buzzer of low sound level as part of a lamp/buzzer unit or to provide a sounder external to the critical space. It is most important that the evacuation plan takes account of the lack of audible evacuation signals in such areas.

5. Manual Call Points

BS 5839 Part 1 Para 10

5.1 The use of telephones as call points is not permitted.

BS 5839 Part 2 (Specification for manual call points)

5.2 A call point that can be broken with relative ease without the use of a striker, and one that prevents injury from glass fragments, is preferred for hospital use.

5.3 Key operated manual call units are not recommended for use in hospitals. They were originally used in some hospitals to reduce the possibility of patient interference. The potential loss of keys is considered a greater hazard than the misuse of the conventional break glass unit.

BS 5839 Part 1 Para 10.2

5.4 Manual call points should be located so that they are readily accessible on escape routes. In nursing sections a manual call point should be provided near the Nurses' Station. Additional call points may be required, eg to ensure that no person need travel more than 30m from any position within the building to raise the alarm. As delay in raising the alarm can be critical, in patient and other high risk areas, a distance of less than 30m may be desirable.

5.5 In some works areas such as service ducts where escape routes may be less straightforward, a more extensive provision of manual call points may be necessary.

5.6 Wherever possible all manual call points serving a hospital site should be identical. This will facilitate training and obviate confusion.

BS 5839 Part 1 Para 10.1

5.7 Any delay between operation of a call point and sounding the alarm will delay the arrival of assistance. Additionally, if the sounders do not sound immediately, the person who raised the alarm may become confused, and perhaps travel towards another call point, consequently delaying any first aid fire fighting or rescue action that they should be undertaking until the alarm eventually sounds. It is recommended that for all new systems in hospitals any delay between operation of a call point and sounding the alarm should not exceed three seconds. The British Standard will reduce the permitted delay between the operation of a call point and the raising of the alarm from the present eight seconds, to three seconds on 1 January 1990. To prevent the possibility of confusion or inappropriate responses being made where a system having a delay exceeding three seconds is installed, it should be impressed upon staff during training that a delay is built into the system.

6. Automatic Detectors

General Characteristics

BS 5839 Part 1 Paras 11, 12, 13

6.1 A summary of the characteristics of the main type of fire detector is given in Table 1. Some models of detector incorporate more than one type of detection element.

Table 1 Performance of Detectors

Type of Detector	Comparison of Types	Principle of Operation	Advantages	Disadvantages
HEAT	General purpose detection. Less likely to give false alarms than smoke detectors, but generally less sensitive.	Fixed temperature	Less likely to give false alarms where large temperature variations occur, eg kitchens, laundries.	Slower response than rate of rise, particularly at low ambient temperatures.
		Rate of rise of temperature (includes fixed temperature)	Will respond more quickly than fixed temperature detectors.	Could 'false alarm' if large rapid temperature variations occur.
SMOKE	General purpose detection. Detects smoke-producing fires at an earlier stage than heat detectors.	Ionisation chamber	Very sensitive to free burning fires which produce small smoke particles.	Insensitive to smoke with large particles, eg smouldering fires; or 'aged' smoke, eg after passing from a room into a corridor.
		Optical	Sensitive to fires which produce smoke with larger particles.	Insensitive to smoke with small particles.
FLAME	Special purpose detection, eg liquid fuel outdoors, and very high ceilings. Line of sight detection.	Infra-red	The emission transmits well through smoke. Sensitive to carbon based fires ie wood, plastics, hydrocarbons.	Hot bodies do not emit in this band. Not sensitive to non-carbon based fires, eg hydrogen, magnesium. Less sensistive to burning alochol and liquid natural gas.

Table 1 Performance of Detectors (Continued)

Type of Detector	Comparison of Types	Principle of Operation	Advantages	Disadvantages
FLAME		Ultra-violet	Sensitive to all types of fires.	Sensitive to welding. Poor transmission of this wavelength through smoke.
HEAT THERMAL TURBU-LENCE DETECTOR	At present is only found incor-porated into long-beam smoke detectors; it is then suitable for general use.	Optical, detects hot air currents.	Covers large area.	Unsuitable for general use unless smoke detection facilities are incorporated.

6.2 Table 2 classifies detectors according to their type and area of operation. The classification is used in Table 3 to identify the appropriate detector for each protected area.

Table 2 Classification of Detectors

Detector Arrangement	Responsive to	Relevant British Standard	Designation Number	Area of Operation or Effectiveness of the Detector
Point	Heat	BS 5445 Part 5 or Part 8	(1)	Within the range of a fixed point sensor forming part of the detector.
	Smoke	BS 5445 Part 7 or BS 5446 Part 1	(2)	
	Radiation (flame)		(3)	
Line	Heat	In preparation	(4)	(4A) In vicinity of a sensor in the form of a cable. (4B) In the vicinity of a light beam produced by a thermal turbulence detector.
	Smoke	BS 5839 Part 5	(5)	In the vicinity of a light beam produced by an obscuration detector
Sampling	Smoke	–	(6)	In the vicinity of a number of fixed points. (Samples are drawn into a sensor, in turn or simultaneously, from each point.)

6.3 Removal of detectors of the plug-in type is facilitated if they can be detached by means of a tool at the end of a pole. To prevent unauthorised removal of detectors, it may be necessary in some locations to provide detectors with locking devices so that they can only be detached by the use of a special tool.

6.4 Where addressable detection systems are used and the address unit of each detector is located within the removable detector rather than in its fixed base, the problem identified in BS 5839 Part 1 para 29.4.5 should be mitigated by the introduction of a suitable local management procedure, the purpose of which is to reduce the possibility of inadvertent misplacement. This may be facilitated, for example, by labelling each detector base and its associated detector with unique identification markings.

Performance and Reliability of Detectors

6.5 The most satisfactory indication that a detector is designed to perform adequately and reliably is its compliance with the latest British Standards. Wherever possible, only detectors certified against a recognised quality approval scheme (see paragraph 1.14) should be used.

Fire Detectors for Life Protection

6.6 Smoke detectors are recommended in certain wards and other patient areas listed in Table 3 because of the need for the earliest possible detection of fire for life safety purposes. The rationale underlying the guidance is that those wards which are statistically more likely to have life-threatening fires and in which staff supervision is relatively meagre should be provided with full detector coverage. On the other hand, in wards where staff surveillance is continuous, automatic detection would be considered unnecessary except in rooms having a high fire risk and in certain common spaces.

6.7 The type of fire risk should be taken into account in selecting the appropriate detector for a particular area, see BS 5839 Part 1 para 11.5.

6.8 Where practicable, a mixing of ionisation and light scatter detectors is recommended in the wards listed in Table 3. This does not mean the duplication of detectors. Ward furnishings recommended in HTM 87 are resistant to smouldering ignition sources, and any smouldering fire which does start is likely to take some time to reach a life-threatening state by which time the smell of burning would probably have been noticed. On the other hand, a large flaming ignition source could very rapidly lead to hazardous conditions making early detection of such fires vital. If only one detector is to be installed it should be of a type responsive to flaming fires in typical ward materials.

Table 3 Areas Where Automatic Detectors are Recommended

Area	Spaces Requiring Detection	Type of Detector & Designation Number (see Table 2)
Patient sleeping areas and day spaces (and associated spaces eg ward offices) (See Note 1)	The following wards: Geriatric) Note 2 Mental Illness) Mental Handicap Young Severely Handicap Orthopaedic	Smoke (2)
Circulation and Communication Spaces (See 6.6, 6.9 and Note 3)	Escape routes where automatic door holders are provided and where they are not activated by detectors in adjacent compartments, sub-compartments and hazard rooms. (see 7.4 and HTM 81, para 20.16).	Smoke(2) (Optical type)
	Corridors and stairways not in frequent use or locked off at certain periods.	Smoke (2) (Optical type)
	Certain ducts, voids, roof spaces etc as Note 4.	Smoke (2) or Heat (1 or 4A) as appropriate.

Table 3 Areas Where Automatic Detectors are Recommended (Continued)

Area	Spaces Requiring Detection	Type of Detector & Designation Number (see Table 2)
Computing	As Note 4	Smoke (2 or 6)
Common or Rest-Rooms	Where smoking allowed, and as Note 4	Heat (1)
Dining-Room	For more than 50 people, and as Note 4	Smoke (2)
Kitchens	Main kitchens	Heat (1 or 4A)
	Domestic kitchens where food is cooked.	Heat (1)
Laboratories	As Note 4	Heat (1) or Smoke (2) as appropriate
Laundry	Main laundry	See Fire Practice Note 1
	Domestic laundry/ ironing rooms containing significant quantities of linen.	Heat (1)
Lecture room	For more than 50 people, and as Note 4	Smoke (2)
Library	As Note 4	Smoke (2)
Pharmacy Dispensing	Where flammable substances are present in significant quantities	Heat (1)
Refuse and Disposal	Incinerator room Rufuse Chute Refuse Chamber	Heat (1)
Service	Boiler room	Heat (1)
	Electrical plant room (as Note 4)	Smoke (2) or Heat (1 or 5)
	Emergency Generator room	Heat (1)
	Gas Manifold room	Heat (1)
	Mechanical Plant room (as Note 4)	Heat (1) or Smoke (2)
Sterilizing (eg CSSD, HSDU)	Autoclave and packing (as Note 4)	Smoke (2 or 5)
Stores	Central Stores	Heat (1 or 4B) or Smoke (2 or 5) to suit contents

Table 3 Areas Where Automatic Detectors are Recommended (Continued)

Area	Spaces Requiring Detection	Type of Detector & Designation Number (see Table 2)
	Flammable Liquids	See Fire Practice Note 2
	Linen store	Smoke (2)
	Patient records	Smoke (2)
	Mattress/mat store	Smoke (2)
	X-Ray film store	Smoke (2)
	Other stores as Note 4	Heat (1) or Smoke (2)
Staff changing	Open clothes hanging	Smoke (2)
Wax bath	-	Heat (1)
Workshop	As Note 4	Heat (1) or Smoke (2)
Fire Hazard Room	Any room so designated (see HTM 81) and not covered elsewhere in this table.	Heat (1) or Smoke (2)

Note 1 - Detectors may be required in other types of ward where ward layout is not conducive to good observation from the nurses' station.

Note 2 - Includes acute and non-acute.

Note 3 - Attention is drawn to the advice of BS 5839 Part 1 para 13.5.3 that corridor detection alone may not give adequate warning of fire before the corridor becomes smoke logged.

Note 4 - Automatic detection should be provided where there is a likelihood of a fire developing by virtue of the contents or function of the space, or where a fire could have serious economic consequences.

BS 5839 Part 1 Para 13.2

6.9 The provision of automatic detection for life safety in the British Standard is based on the principle that at least the escape routes should be protected (an L3 system, see BS 5839 Part 1 para 3). Department of Health fire safety guidance for new hospitals, however, starts from the basis that there are alternative means of escape. Patient areas that are not under the continuous attention of nursing should be fully protected by fire detectors. Additionally any fire hazard rooms within or adjoining patient accommodation should be protected within a fire resisting enclosure and provided with automatic detection. The effect of this policy is that hospital departments have, in British Standard terms, L2 or L1 systems except that escape routes themselves are not necessarily provided with automatic detection (see Table 3).

Fire Detectors for Property Protection

6.10 The use of smoke detectors in stores and other central service departments arises from the need for the earliest possible warning of fire. The hospital service may depend vitally on these departments, and they may contain expensive equipment. If, however, the fire detection system is to be effective in saving property in these areas then it is vital that the fire is detected when it is small so that it can be easily put out. The type of fire risk should be taken into account in selecting the type of detector for a particular area, see Table 3.

6.11 Large lofty spaces, eg central sterile supply departments, stores and recreation halls may be suited to the use of optical beam detectors. The use of such detectors can result in cost savings, particularly on maintenance, as well as a higher standard of coverage.

6.12 The use of heat detectors is recommended in those areas where the processes being carried on might give rise to a high rate of false alarms if smoke detectors were provided. Whilst in many instances the use of point type heat detectors is appropriate, the use of line detectors may be more economical in large undivided areas.

6.13 More detailed guidance on fire detection is given for Laundries in Fire Practice Note 1, and for Flammable Liquid Stores in Fire Practice Note 2.

6.14 If all or part of the system is to cover a computer room or data processing area the selection and siting of detectors for that area should comply with BS 6266.

Detector Location

6.15 Table 3 lists the areas in a hospital where automatic detectors are recommended. This table is not exhaustive, but gives by example the detector provision that would be expected in some typical areas. It should be interpreted locally to suit particular site circumstances. In addition to the areas listed, automatic detection should be provided where there is a likelihood of a fire developing by virtue of the contents or function of the space, or where a fire could have serious economic consequences. Detectors may also be required in other areas where acceptable standards of passive or structural fire protection cannot be achieved in older buildings.

Siting of Detectors

BS 5839 Part 1 Para 12

6.16 Where automatic detection is required, detectors should be sited and spaced as recommended in BS 5839 Part 1 para 12.

BS 5839 Part 1 Para 12.2.16

6.17 Care should be taken in siting smoke detectors on the ceiling in relation to any ventilation diffusers to ensure that smoke will not be prevented from reaching the detector by supply or extract air movement. There have been cases in hospitals where fires in expensive equipment have not been effectively detected because smoke from the fire was deflected by the air stream from a diffuser located between the equipment and the nearest detector.

BS 5839 Part 1 Para 12.4.2

6.18 The use of detectors in ventilation ducts to protect the area from which air is being extracted is not generally satisfactory.

False Alarms

BS 5839 Part 1 Para 14

6.19 Particular care should be taken in the design of the system and in the selection and siting of detectors to avoid false alarms. The causes of false alarms listed in BS 5839 Part 1 para 14.1 are all common in hospitals.

> Note: False alarms caused by thrip flies have been a serious problem in some hospitals during summer months. Investigatory work into this problem is in hand.

BS 5839 Part 1 Para 14.7

6.20 Transmission delay units are not recommended for use in hospitals. They delay the arrival of the fire brigade to an incident, and may encourage a hasty search of the premises with the possible consequence that a real fire could be overlooked and a genuine call to the brigade cancelled. They do not solve the false alarm problem which concerns the hospital staff.

6.21 Addressable systems containing analogue detectors appear to give fewer false alarms than would be expected with conventional systems, and their use is recommended in hospitals (see paragraph 2.10). Detectors should be individually monitored, and the system should report sensitivity movements that, if not corrected, would be likely to give rise to false alarms or detection failure.

7. Control and Indicating Equipment

7.1 Control and indicating equipment should be provided in accordance with BS 5839 Part 1 para 15.

7.2 All indicators and controls provided to enable the system to be used effectively in the event of an alarm should be simple to understand and use. Indicating equipment should not require more than a few seconds for the assimilation of essential information, and control of functions essential in a fire should not require the use of a QWERTY (typewriter) keyboard or multi-function switches or controls. All controls and indicators should be adequately labelled so that their use and purpose is readily apparent. The operation of an addressable system should be simple and immediately obvious to a person familiar with conventional systems.

7.3 In all but the smallest installations, alarm sounders will need to be grouped into evacuation zones and arranged so that alarms are given according to a preset pattern, eg 'evacuate' alarm in the fire zone, 'alert' alarm in adjacent zones and maybe in other selected zones, and no alarm elsewhere. With such equipment, the functions of manual controls for the sounders need to be carefully considered: it may be necessary to have separate 'silence alarm', 'evacuate' and 'alert' controls for each zone.

7.4 Whilst hold-open devices on doors would ideally be controlled on an individual basis this is unlikely to be logistically feasible. In practice it will usually be satisfactory to arrange for the doors on hold-open devices within and bounding a number of fire alarm zones (often all the doors on one floor) to operate in response to an alarm from any one of those zones. The pattern for releasing doors on hold-open devices should be agreed with the management of the department(s) concerned. Facilities should be provided at the control equipment to both automatically and manually release the doors according to this preset pattern.

BS 5839 Part 1 Para 6

7.5 The removal of a detector or call point from a circuit should cause a fault warning, as required by BS 5839 Part 1 para 6.6.2.

7.6 The control and indicating equipment should have spare capacity to allow for possible future extensions.

Computer Based Systems

7.7 The performance of a fire alarm system will depend upon the reliability of the communication between the various system components. In designing the computer protocol for computer based fire alarm systems, the manufacturer should have regard to the computer industry standard BS 5397 Part 1. Where the system uses other protocols, such as time modulation, manufacturers should take steps to ensure that electromagnetic interference does not compromise the performance of the system. See also paragraph 9.2.

Isolation

7.8 It is often necessary for parts of the system to be isolated while building or other work that might cause false alarms is carried out. This should be possible by a simple-to-use, integral control(s) on the control and indicating equipment. While any part of the system is isolated or in any way disabled by a manual function, a fault warning should be displayed that identifies the nature of the fault.

Program Modifications

7.9 The modification of the control programs for addressable fire detection and alarm systems is a specialist task that should normally be undertaken by the system supplier. The following recommendations apply:

a. Facilities or controls for the modification of the stored program should be in accordance with the recommendations of BS 5839 Part 4.

b. A method by which changes to the stored program may be made should be agreed between the System Supplier and the Health Authority. A Permit-to-Work System is recommended. The number of approved personnel should be strictly limited.

c. All modifications to the stored program should be indicated in the Event Log Book and recorded in detail in the system operating manual.

d. Recommissioning tests should be carried out before the system is put back into service.

Non-Essential Items of Equipment

7.10 Certain items of equipment such as visual display units and printers require mains electricity supplies. Where, as should always be the case, these items supply supplementary rather than essential information (any requirements made by BS 3116 Part 4 or BS 5839 Part 4 are regarded as essential) there is

no requirement to provide a stand-by to cover periods of mains failure.

Printers

7.11 Many addressable systems incorporate a printer, either as a standard item or as an optional extra. The use of such components is recommended as a useful addition to any system. They can be invaluable in the provision of data on both real and unwanted alarms. The discipline for handling the printed record should be laid down in the fire instructions.

Output Displays

7.12 Visual display units or fluorescent displays should be used where they can assist in providing information, see also paragraph 2.7 and Appendix A2.13 - A2.17. Displays should be sited in relation to luminaires and windows so as to minimise reflected glare from the screen or display face. Output display, unless self-lit or backlit, should be illuminated by the emergency lighting to at least five lux in the vicinity of the display

8. Power Supplies

8.1 Power supplies should be provided in accordance with BS 5839 Part 1 para 16.

8.2 In hospitals provided with emergency electrical supplies in accordance with HTM 11 the essential electrical services are powered from an automatically started stand-by generator in the event of a failure of the normal supply. Under these arrangements, the generator may replace a proportion of capacity assigned to the secondary battery stand-by supply for the fire alarm system as permitted in BS 5839 Part 1 paras 16.3.2.2 and 16.5.1.4. The fire alarm system, including any separately powered alarm sounder circuits, should be connected to the essential circuits.

8.3 In large premises, especially where buildings are widely separated, power supply equipment for operating alarm sounders should be located locally so that long cable runs with excessive voltage drops are avoided.

8.4 Warning: Lead Acid and Alkaline batteries should not be housed together in the same room or enclosure. Hydrometers or other equipment used on Lead Acid batteries should not be used on Alkaline batteries, and vice-versa.

9. Cables and Wiring

BS 5839 Part 1 Para 17

9.1 In selecting cables for an installation the recommendations of BS 5839 Part 1 para 17 should be followed. In particular, advantage should be taken of the relaxation of BS 5839 Part 1 para 17.15 where appropriate.

9.2 In addition to any protection from the effects of fire, or from mechanical or electrical damage, required by BS 5839 Part 1, consideration should be given to the protection of the wiring installation from electromagnetic interference. This is particularly important with computer based systems where transmitted data may be corrupted by such interference. Good protection may be afforded by the use of properly installed and maintained steel conduit and trunking. Cables having twisted cores and/or an integral metallic screening may also afford protection. See also paragraph 7.7.

BS 5839 Part 1 Para 24.4.2

9.3 Particular care should be taken during the installation of cables having metallic screening to see that the screen is properly finished off at terminations. There have been cases where a gap left between the screen and the termination point has acted as an aerial and picked up radio frequency emissions which have caused the fire alarm system to give a false alarm. Cables should be installed in accordance with any specific manufacturers' recommendations.

10. Radio and Electrical Interference

BS 5839 Part 1 Para 20

10.1 Hospitals tend to generate and suffer from a high level of radio frequency interference, and false alarms have reportedly been caused by on and off-site radio transmitters and portable radio telephones, as well as electromedical equipment. At the time this guidance was prepared, British Standards did not specify immunity limits for fire alarm systems or system components. International Standards in preparation may set immunity levels and test methods for fire alarm system components. Until a suitable Standard is available, it is recommended that where possible only devices which have been shown to meet severity level 3 of BS 6667 Part 3: 1985 are connected to fire alarm systems in hospitals. Even equipment which meets BS 6667 Part 3 may be susceptible to high power sources such as diathermy equipment and this should be considered in siting of fire alarm devices and in selection, installation and routing fire alarm cable, see paragraphs 9.2 and 9.3.

11. Installation and Commissioning

BS 5839 Part 1 Section three

11.1 Workmanship, installation and commissioning should be in accordance with BS 5839 Part 1 Section three. The installation and commissioning of the system should be programmed in a logical and efficient manner and in such a way that clashes with other building works are avoided and disruption to the hospital's operational procedures is minimised.

Insulation of Cables and Wires

BS 5839 Part 1 Para 26.3

11.2 Wiring that has been subject to a test with a 500 volt Megger should be discharged to earth before being connected into electronic equipment as the electrical charge stored between the cores and the sheath or between cores may cause damage.

Commissioning

HTM 17

11.3 Attention is drawn to Hospital Technical Memorandum 17 Health Building - Engineering Installations, Commissioning and Associated Activities.

11.4 The commissioning of the fire alarm system should be programmed in such a way that each stage of the exercise is carried out in a logical manner:-

a. inspection of installation

b. insulation and earthing tests of all cables and wires. (Generally this is carried out in the course of cable installation).

c. initial operational testing.

d. full commissioning test.

11.5 Before commissioning, it is recommended that consideration be given to the method employed, number of staff required to carry out the operation, provision of tools, instruments and ancillary equipment needed such as ladders, stagings, keys for all department doors, etc, so that the programme can proceed in an efficient way and minimise the amount of man hours spent on site.

11.6 To minimise the total time spent travelling between zones and the main control panel area, the testing personnel should be in direct communication with each other. Where an adequate telephone system is not available at the time, consideration should be given to the use of a portable two-way radio communication system.

BS 5839 Part 1 Para 26.5

11.7 In addition to the commissioning tests required by BS 5839 Part 1 para 26.5 the following are recommended:-

11.7.1 A schedule of all possible fault conditions should be drawn up in chart form with the anticipated responses of the system indicated against each fault. The responses should include the illumination of general and dedicated fault indicators, the energisation and silencing of fault sounders and the wording of any textual messages to be output by visual display units, fluorescent displays and printers.

11.7.2 Faults should be induced in every addressable device (usually by unplugging it) and the correct response established. A check should be made to establish that the devices in question are correctly identified in terms of their address number and their textual description.

11.7.3 Cables serving sensors, detectors and sounders should be subjected to open-circuit, short-circuit and earth faults to establish correct response. While the faults are present, the requirements of BS 5839 Part 1 para 6.6.2 should be verified by fire testing other items connected to the same cables in other zones.

11.7.4 Isolation facilities not tested by the procedures of paragraph 11.7.3 should be checked.

11.7.5 Each detector, sensor and call point should be 'fire' tested (see paragraph 12.9) to establish that it functions correctly and that it is correctly identified in terms of its address number, its textual description and its zone, and that the appropriate sounders and visual alarms and displays respond correctly.

11.7.6 Mains fail, battery disconnect and charger fail tests should be carried out on all items of power supply equipment to establish that the system responds correctly and continues to operate despite the presence of any one fault.

11.7.7 It is recommended that where the audibility test under BS 5839 Part 1 paragraph 26.5(a) is carried out with the building unoccupied, this test is followed by an audibility test with the building in full normal use.

11.7.8 Where audible or visual warnings are designed to have an intermittent or pulsed output, the temporal pattern should be checked (see paragraph 4.4).

11.8 The commissioning tests, including all test results, should be fully documented.

12. User Responsibilities

BS 5839 Part 1 Para 28.1

12.1 In addition to the procedures identified in BS 5839 Part 1 para 28.1.2, consideration should be given to:-

a. forewarning staff whenever servicing requirements may cause fire alarm sounders or visual warnings to operate,

b. ensuring that staff will respond promptly and correctly to any real alarm which may occur during testing.

Training

12.2 The efficient use and continuing effectiveness of fire alarm systems requires that the personnel involved in their operation and maintenance should be adequately trained. As fire detection systems are infrequently actuated under real fire conditions there is a need to run a continuing programme of refresher courses which may also be used to cover the training of freshly transferred staff. The courses should be designed to meet the requirements of individual disciplines, but at least the following items should be considered for inclusion:-

a. the function and use of all system controls;

b. the purpose of all system indicators;

c. the position, type and function of all system components. This will involve a tour of the protected premises in which system components are identified;

d. the location and use of the operating and, where appropriate, the maintenance manuals;

e. the use of the Event Log Book;

f. the location and use of as-fitted drawings;

g. the purpose and control of any linked ancillary equipment such as door control and extinguishing systems.

Servicing

BS 5839 Part 1 Para 29.1

12.3 Where servicing of the installation is carried out by Health Authority staff, the authority should ensure that the personnel are competent and fully trained.

12.4 Because of the specialised and complex nature of modern computer based fire alarm systems, it will usually be necessary to employ the supplier or his agents, or a specialist contractor, for at least some aspects of maintenance. For this reason it is particularly important that maintenance is considered at system/supplier selection stage of the project (see paragraph 1.10). The maintenance contractor should be fully conversant with the characteristics of the system, and in the case of a computer based system, will require access to relevant computer software. Where practicable, the maintenance contractor should be approved to a relevant quality approval scheme (see paragraph 1.14).

12.5 Where maintenance is contracted out, the agreement should clearly define the client's (Health Authority) and the contractor's responsibilities, and should make the contractor liable for direct and consequential losses. The contractor should be responsible not just for servicing the system at specified frequencies, and attending to breakdowns, but also for the performance of the system. The contractor would be liable for costs resulting from certain false alarms, and through failure of the system to respond correctly to fire. Failures resulting from misuse or abuse by the health authority would be excluded. The Department of Health has provided the NHS with guidance entitled Model Contract Documents for Estate Management and Minor Works which advises on lump sum term contracts which would be suitable for this type of work.

Routine Attention

BS 5839 Part 1 Para 29.2

12.6 Some addressable fire alarm systems incorporate certain internal, self-testing facilities which may reduce the amount of testing required. Where these facilities are provided advantage may be taken of the relaxations offered by BS 5839 Part 1 para 29.2.1.

12.7 The monthly testing of automatic start emergency generators used as part of the fire alarm system stand-by supply required by BS 5839 Part 1 para 29.2.5 may be replaced by a six-weekly test having the same content. A six-weekly test of generators is recommended in the DHSS Works Information and Management System (WIMS) Advice Note E0801.

12.8 In addition to the requirements of BS 5839 Part 1 para 29.2.6, a procedure should be developed for replacing batteries at the end of their useful life; it is recommended that batteries should be labelled to show their due replacement date. Attention is drawn to WIMS Advice Note E0701 regarding the routine maintenance of secondary cells, E0702 regarding battery charging equipment, and E0703 regarding battery stands and trays.

Manual Call Points

12.9 In addition to the recommendations of BS 5839 Part 1 para 29.2.7, it is recommended that each manual call point should be tested by operating any built-in test facility (provided this directly simulates operation of the device, eg the facility must operate the contacts which are normally used), or by releasing the device's door or frangible cover.

Smoke Detectors

BS 5839 Part 1 Para 29.4.3

12.10 Whether or not the detectors have been removed, the annual check of BS 5839 Part 1 para 29.2.7(b) should be followed by a final in-situ test with smoke, or simulated smoke. This is a test for operation, it is not a sensitivity test since no suitable in-situ smoke sensitivity measuring equipment is currently available. The Harwell/Martindale smoke detector tester is no longer recommended for sensitivity testing of smoke detectors; SIB(87)51 refers.

12.11 In developing test procedures and selecting appropriate test equipment the advice of the manufacturer or supplier of the system should be followed. This is particularly important where test smoke or aerosols are involved since some types can severely contaminate smoke detectors or sensors, while others may be usable only with particular types.

Extensions/Modifications to Existing Fire Alarm Systems

BS 5839 Part 1 Para 27

12.12 The continuing effectiveness of an existing fire alarm system may be impaired as a result of changes to building configuration or use. The procedures to be followed when extensions or modifications to existing systems become necessary are covered in BS 5839 Part 1 para 27.

12.13 Experience has shown that in some instances an extension to, or alteration of, a fire alarm system has been ineffective because proper recommissioning has been overlooked (see chapter 11). In the case of addressable systems, extensions or alterations may also require software modifications which must also be properly commissioned (see also paragraph 7.9).

Spares

BS 5839 Part 1 Para 29.6

12.14 The user should hold spares of each type of removable point type detector or sensor in use on the system. Spare ionisation detectors should be stored in an appropriate store approved by the local office of the Health and Safety Executive. The issue and return of these detectors should be recorded.

Appendix 1 Briefing Check List

A1.1 This check-list, which is not necessarily exhaustive, is intended as a aide-memoire for the briefing decisions. It should be read in conjunction with BS 5839 Part 1 paras 4 and 5.

	HTM 82 reference
1. Nominate the responsible person (as defined in BS 5839 Part 1 para 2.13), who will be a member of the planning team.	1.10
2. Define the extent and purpose of the system (ie life or property protection).	2.2
3. Consider the need for the fire alarm system to actuate other fire safety systems.	2.8
4. Consider the need for external monitoring, ie by building management or other non-fire related systems.	2.11
5. Identify the user activity in each protected space in order that the type of detection required, eg heat, smoke (ionisation or optical), or flamed, can be established.	6.7
6. Consider the interaction of the fire alarm system with fire routine of the hospital. This will include the actions of staff in the event of fire or fault warnings.	1.10, 2.6
7. Consider the need for printers, visual display units, repeater panels, alphanumeric displays, etc, the information they are required to impart, and their locations.	2.7
8. Consider the location of control and indicating equipment	2.4
9. Define the duration of the stand-by power supply, and the location of battery chargers and batteries	8
10. Define the type of communication that is required with the fire brigade.	3
11. Consider the type of alarm sounders to be used	4.4, 4.5
12. Identify the areas requiring staff alarms.	4.6
13. Identify the areas requiring visual fire warnings.	4.13
14. Identify and name detection and call point zones, and in the case of addressable systems, detectors and call points themselves.	2.5
15. Identify and name sounder groups (evacuation zones)	2.6, 7.3
16. Identify control and indicator equipment outputs for any given input, eg the sounder groups that will operate intermittently and those that will operate continuously, and the doors on hold-open devices that require to be released, in response to a signal from each detection zone.	2.6, 7.3, 7.4
17. Consider the provision and function of manual controls on the panel, eg alarm silence and reset facilities.	7.2
18. Identify any areas that will require specially protected equipment.	2.12
19. Define the type of wiring required, and consider the general form of wiring arrangement to be made, ie surface, trunking, concealed, etc.	9
20. Prepare a programme for the installation, commissioning and handover of the fire alarm system.	11.1
21. Consider training requirements, for selected members of hospital staff in the day to day operation of the fire alarm system, and all staff in their response to fire alarms.	12.2
22. Identify hospital staff who will need special training in the use and maintenance of the system.	12.3
23. Identify maintenance responsibilities of hospital staff and contractor.	12.4
24. Consider the type of call out arrangements that should be made to deal with system faults.	12.4
25. Consider the type of maintenance agreement required.	12.5

Note: After the design briefing decisions have been taken, the fire routine should be documented, and ultimately incorporated in the user documentation.

Appendix 2 Explanation of Addressable Fire Detection and Alarm Systems

This Appendix is intended to give a general description of the properties of addressable systems (see paragraph 2.9); it should not be used as a specification.

Types of System

A2.1 Fire detection systems can be divided into two main types which for the purposes of this guidance are called 'conventional' and 'addressable'. Conventional and addressable systems use much the same detection principles and techniques but differ in the methods of signalling and the type of information that is available to the user. Addressable systems usually employ one or more microprocessors to control the various system functions and the decision as to whether the information received by the sensing element of the detector does or does not represent a fire is usually made at the control equipment. With conventional systems the decision is almost always made at the detector. Where the fire/no fire decision is made at the control equipment, the detection devices may be referred to as sensors rather than detectors.

Zoning on Conventional Systems

A2.2 Conventional systems are divided into fire (detection) zones which correspond to the various fire compartments of the building, installation or structure protected (see paragraph 2.5). Up to 20 detectors may be wired in parallel on one zone and a fire signal from any one of them will result in a common alarm signal at the control and indicating equipment. To identify the source of the alarm it is usually necessary to conduct a physical search of the zone (fire compartment) in order to determine the detector which has operated. BS 5839 Part 1 para 7.2 recommends that detection zones should not be greater than 2,000 square metres so that search times do not become too protracted. Zones in hospitals are usually much smaller than this.

Zoning with Addressable Devices

A2.3 Some addressable systems have a facility that allows the sensor providing the information on which the fire decision is based to be individually identified at the control and indicating equipment, so that there is no need for the physical search process to pinpoint the exact source of the alarm. Other system components such as call points, sounders, mimic displays, etc may also be individually identified or controlled, even though they share common wiring. Devices that can be individually identified and/or controlled are known generically as 'addressable'.

A2.4 In these circumstances each detector/sensor or call point is identified at the control equipment as if it was an individual 'zone' on a conventional system. The building should nevertheless be zoned for evacuation management purposes. (see paragraph 2.5).

A2.5 For alarm output purposes, sounders may be controlled either individually or as groups. The sounders forming a particular group are not rigidly fixed and, with suitable programming, can vary, depending on the source and type of alarm, regardless of the way in which they are wired.

A2.6 An 'addressable' device is usually given a dedicated code that identifies its position and function in the fire detection and alarm system. Communication with the 'addressable' device normally takes the form of the control equipment outputting a message to the lines on which the device is wired, to which only the device will respond. The response may be to signal back its status or to provide analogue information on the amplitude of the sensed parameter. Depending on the type of system the communication code may be signalled as a series of 'ones' and 'noughts' (digital) or it may be signalled as one or more variable voltage or current levels or durations (analogue). Note that it is usual for analogue information to be converted to a digital form for signalling purposes.

A2.7 The normal sequence of operation is for the control equipment to 'interrogate' each device in turn although in some systems the detectors or call points can initiate an alarm without waiting for an interrogation (interrupt). The time taken to interrogate every device in the system is known as the 'scan time'. Priority is usually given to call points and in some systems these are scanned more frequently than other system components. Devices such as sounders may be scanned less frequently as all that is necessary with devices of this type is to ensure that they are still connected to the system. The 'interrogate/answer' sequence provides evidence that all system components are connected to the system and obviates the need for the 'End Of Line' monitoring devices that are employed on a conventional system. Whereas the 'End Of Line' devices only show that the lines to components are intact, the interrogate/answer sequence actually provides evidence that the components are connected to the lines and are capable of responding.

A2.8 On most systems the address of a device is fixed during the commissioning procedure by setting switches or cutting links on the associated printed circuit board. It is possible for the Commissioning Engineer to make an error and inadvertently give two

devices the same address: all systems should have a fault monitoring facility that will indicate when this happens. On other systems there is a 'start up' procedure in which the control equipment scans the system and ascribes a software address to each device. Here there is less possibility of human error and less fault monitoring may be required.

A2.9 For fire management purposes a broad indication of the area in which the fire has occurred (eg 5th floor) may still be useful and for this reason the continued use of notional detection zones is recommended, although to reduce installation costs they may be software generated rather than hard wired. Note that the term 'software generated' implies that, although 100 or more sensors may be connected to the same pair of wires, which may run through several fire compartments, the processor is programmed to sort them into groups corresponding to their location in the various fire compartments for information and display purposes.

Analogue Systems

A2.10 Sensors connected to an 'addressable' system usually send back a signal to the control equipment that is a measure of the amplitude of the sensed parameter (smoke density, temperature, etc). The control equipment will interpret this signal and may compare it with signals from other sensors protecting the same area and with the previous history of the sensor in question, before reaching a fire decision. The program method used to analyse the signals from the various sensors and call points and to decide whether or not a fire condition exists is called the 'fire algorithm'. Other algorithms may be used to determine fault outputs, etc.

A2.11 The fire algorithm may well vary with sensor type. Where this is the case the first stage in the analysis must be to determine what type of sensor is responding. If the sensor does not identify its type with the information it sends back to the control equipment the base arrangement must be such that the wrong type of sensor cannot be plugged in. It is necessary to 'configure' some systems either before or during the commissioning stage. Configuration is the process whereby the control equipment is told what types of sensors, call points, sounders, etc. it should expect to find on the system and what their address codes are. This information is usually provided by an 'EPROM' which is a once only programmable memory chip.

A2.12 The process of placing the program on the chip is known as 'blowing'. Blowing is normally done by the System Manufacturer, but it is important that the program information is checked by the System User before the blowing process.

Output Displays

A2.13 The source of fire and fault information should be identified on a zonal basis using lamps or light emitting diodes as required by BS 5839 Part 4. In addition, it is possible for addressable systems to control fluorescent displays which can be strategically positioned throughout the premises. Fluorescent displays usually have the capability of displaying 20 letters or numbers and can be programmed to provide information on the source of a fire and perhaps to provide evacuation control messages. Displays can be addressable and can, therefore, be individually controlled.

A2.14 Displayed messages need not be identical throughout a premises and it is often useful for displays remote from the fire to display the general area of origin, whereas displays close to the fire source can display the actual room (number or name).

A2.15 While the system is in its quiescent state it is useful for the displays to show the time and date. This has three advantages:-

a. the personnel within the building get into the habit of looking at the displays and in the event of a fire will be aware of the display locations;

b. the display will provide a useful service;

c. it will quickly be reported if one of the displays has failed or its outputing corrupted information.

A2.16 A variation on the fluorescent display is the liquid crystal display. This provides the same type of information as a fluorescent display and in much the same form, but suffers from the disadvantage that it needs a good level of lighting to be readable.

A2.17 Visual display units (which are similar to a television monitor) can be used to output information on a fire in the same way as fluorescent displays. They can also be programmed to provide graphics information and may, for example, show an outline plan of the protected building with the fire source indicated by a flashing red flame. The use of an associated keypad can make the system interactive so that it is possible, on command, to enlarge the scale of the displayed plan and to give information on escape routes and fire fighting appliances in the immediate area of the fire. Clearly there are many options available that are only limited by the imagination and budget of the system specifier.

'Smart' Detectors

A2.18 One variation on the usual arrangement of addressable systems is where the detector incorporates its own microprocessor. That is known as a 'smart' detector.

A2.19 Systems incorporating 'smart' detectors differ from the normal addressable system in that the intelligence is embodied in the detector as well as, or instead of, the control unit. The usual function of the microprocessor in an addressable detector is to

analyse the analogue signal generated by the detector and to compare it with the previous history of that signal. The microprocessor compensates for long term drift and maintains the sensitivity to the sensed fire parameter at a constant level regardless of any build up of dirt within the detector. It differentiates between the changes produced by a fire and those produced by normal changes in the ambient, on a time related basis.

Multi-State Alarm Outputs

A2.20 The use of addressable systems and/or addressable detectors enables the system response to be more flexible than that produced by a conventional system and allows for several stages of alarm output to be generated. The stages may include a pre-warning of fire, a confirmation of fire, a low sensitivity fault signal and a high sensitivity fault signal. The latter two signals draw attention to the need to clean and service the sensor and are useful in pre-empting false alarms. The pre-warning of fire does not generate an automatic call to the fire brigade but draws attention to the need to conduct a search of the protected area to establish whether or not the sensed output represents the early stages of fire or is just a response to an environmental condition, such as dust, that can be ignored.

Audible Alarms

A2.21 As with fire sensors, audible (and visual) alarms may be hard wired or they may be addressable and software controlled. In some addressable systems, alarms and sensors may share common wiring.

'Watchdog' Circuit

A2.22 Microprocessors and computers are potentially vulnerable to a fault condition that cannot occur on conventional systems. This fault, which is variously known as a 'lock-up', a 'hang-up' or a 'glitch', occurs when there is an error in part of the program or when the program representation in the computer memory becomes corrupted. Under these conditions the processor goes into a continuous loop, from which it cannot escape, and repeatedly performs the same trivial sequence of instructions until it is reset by an external agency. The external agency should be a 'watchdog circuit' which monitors by electronic (non-program) means that every few seconds the processor is performing an anticipated task. When the task is not carried out a fault signal is given and an automatic restart procedure is instigated.

Commissioning

A2.23 Recommendations for commissioning are given in chapter 11. Attention is drawn to procedures to test diagnostic routines, programmed functions and fire output information which in the case of addressable systems test the computer software as well as system hardware.

Appendix 3 Automatic Transmission of Fire Alarm Signals

This Appendix gives an explanation of the principles of operation of various automatic methods of alarm transmission. It also contains some specific recommendations on the use of ambulance radio networks (A3.37), and on the use of digital communications and 999 autodiallers (Appendix 3A).

Means of Connection to Fire Brigade Control Rooms

Various methods by which fire signals can be transmitted from protected premises to the fire brigade - without using a remote manned centre - are shown diagrammatically in Figure A3(1). It should be noted that one of these methods, the 999 autodialler, is not considered acceptable for hospitals (see para 3.13). The advantages and disadvantages of the acceptable methods are summarised in Table A3(1). Paragraphs A3.1 to A3.14 describe the principles of operation of each method.

Private Wire Connections

A3.1 Although this type of connection is a 'direct connection' between protected premises and a fire brigade control, and is often diagrammatically indicated as such, in practice the connection is made by BT in a telephone exchange, from where a dedicated circuit is run to the protected premises and the fire control. Over long distances, the connection may actually run through several exchanges.

A3.2 Traditionally, d.c. signalling is utilised. A constant voltage is applied to the line, allowing a current to flow for monitoring purposes. Any break in the line is, therefore, immediately detected and results in a fault warning. A fire signal results in a reversal of the line's polarity which is sensed as an alarm signal at an indicator board in fire control. This system is still in existence in a few brigade control rooms but tends to be unpopular with BT. It is normally suitable only over restricted distances (5-10 miles) because of volts drop along the line. However, one brigade have modified their equipment to use higher resistance relays, so reducing the line current. This allows terminations to be accepted from protected premises within a thirty mile radius.

A3.3 In the case of a small number of brigades, an alarm company's proprietary signalling system is used. This operates in the same manner as the company's central station signalling system, but, instead of signals terminating in a central station, they terminate at the fire brigade control room.

Brigade Mobilisation Schemes

A3.4 In some areas of the country, it is possible to transmit signals from fire alarm systems to brigade control using the brigade communications system, by which remote fire stations are mobilised by the control. An early type of system that facilitated this arrangement was known as Voice Frequency 'System A' (VFA), which is now obsolete.

A3.5 A small number of brigades have, however, incorporated facilities for alarm transmission in new communication schemes. In such systems, there is a dedicated private wire between each protected premises and a local fire station.

A3.6 In schemes based on VFA, there is at the fire station a tape player, which plays a pre-recorded speech message to an operator at fire control by means of the brigade communications scheme. In more modern systems, it is possible to replace the tape player with a data transmitter.

'Alarms by Carrier' (ABC)

A3.7 This system of alarm transmission is provided by BT for both fire and intruder alarms in restricted areas of the country. It was originally developed by BT as a replacement for 999 auto-diallers in order to reduce the unreliability involved in 'double handling' and the use of a tape.

A3.8 ABC makes use of the subscriber's normal exchange line, but operates independently of the PSTN. A dedicated telephone line is not normally required because ABC will function whether or not the telephone line is in use for speech transmission.

A3.9 The alarm carrier sender unit, which is powered from the telephone line 50V supply, transmits a continuous signal above the audio frequency range of the telephone equipment. This is used for line monitoring purposes and any failure is automatically transmitted to the BT repair centre. The part of the alarm path between the local exchange and the fire brigade is duplicated.

A3.10 As well as loss of transmission capability, the local processsor is capable of recognising any one of three other states, which the sender can transmit, according to the system used. Normally only one of these would be used - a simple 'Fire' signal, but the facility is there to discriminate between, say, East Wing/West Wing or between automatic detection and manual alarm.

A3.11 Alarm signals, routed from the local processor to a central processor, are ultimately switched direct to a terminal in the fire control. The overall transmission time is around six seconds.

999 Auto-diallers

A3.12 These devices dial 999 in the event of a fire alarm condition and play a recorded message. The BT operator then connects the call to the fire brigade. In remote areas, where BT have no direct lines from telephone exchanges to fire controls, the operator may have to dial an ex-directory number to establish a link to a fire control.

A3.13 The use of this type of equipment is discouraged by many fire brigades, partly due to concern regarding reliability, but also because the brigade has little control over their use or the nature of the message.

A3.14 The fire alarm industry is also tending to phase out the use of these devices, also on the grounds of reliability and the fact that regular testing is not possible.

Means of Connection to Remote Manned Centres

A3.15 Various methods by which fire signals can be transmitted from protected premises to fire brigade control via a commercial central station are shown diagrammatically on Figure A3(2). It should be noted that not all the methods shown are acceptable for hospitals. The advantages and disadvantages of methods of connection to remote manned centres are summarised in Table A3(2). Paragraphs A3.16 to A3.36 describe their method of operation, and paragraph A3.37 gives specific recommendations on the use of ambulance radio networks.

Private Wires

A3.16 This is a form of 'direct connection' between protected premises and a remote manned centre. It is similar in principle to the system described in A3.1 in that there is a dedicated and continuously monitored path between the protected premises and the central station.

A3.17 However, the alarm industry no longer uses d.c. signalling techniques for private wire connections. The a.c. signalling used is more compatible with BT facilities, but, unlike d.c. systems, the actual path may not comprise copper conductors. BT may choose to provide the communications path as part of a multiplexed signalling channel that could, over long distances, even comprise radio or microwave links.

A3.18 The use of a.c. signalling also permits the transmission of many different alarm states, although typically only two states - fire and fault - are actually transmitted.

Omnibus Circuits and Satellite Arrangements

A3.19 These forms of communication were specifically developed to provide an economical means of monitored communication between protected premises and central stations where, for reasons of cost, a private wire would not be feasible.

A3.20 There are two distinct forms of communications architecture, omnibus circuits and satellite arrangements. Omnibus circuits are provided by the Public Telecommunications Operator and are used by many central operators and are also suitable for use by NHS remote manned centres.

A3.21 In an omnibus circuit, a number of subscribers share a common circuit. Differences in the mode of communication exist but commonly an interrogate/reply mode is used whereby the 'host' transmits a coded instruction for, say, transmitter No. 1 to respond. This signal is received by all subscribers' equipment, but only No. 1 responds with an indication of its current state (eg fire, fault, etc). Having received the No. 1 response, the host sequentially 'polls' the other subscribers' systems until, when the scan is complete, it will return to No. 1. Each subscriber's equipment can usually transmit several different alarm states if required.

A3.22 Omnibus circuits are normally limited by BT to 12 subscribers via a maximum of two exchanges. BT prefer all subscribers on a single circuit to be connected via a single, common telephone exchange. This is to make fault finding simpler, but the actual omnibus circuit itself is permitted to pass through many exchanges without 'collecting' subscribers.

A3.23 Satellite arrangements, on the other hand, are provided only by major alarm companies. A satellite is basically an unmanned central station to which the subscriber is connected, either by omnibus circuit or private wire. All signals from the satellite are then multiplexed down a common signalling line to the central station. This so called multiplex bearer may interface with other satellites en route.

Digital Communicators

A3.24 A digital communicator is a signalling device that is connected to an exchange telephone line - normally an ex-directory line used for no other purpose.

A3.25 In the event of fire, a digital communicator dials up a central station using the PSTN. When automatic equipment at the central station answers the call, an electronic 'handshake' is exchanged between the communicator and the receiver. An electronic signal from the communicator is then decoded at the central station and a display of the protected premises code number or address appears on a visual display.

A3.26 A number of permutations in available facilities exist. For instance, some digital communicators have facilities for the connection of two separate exchange lines. The number of times that communicators can attempt to make a call if successive attempts fail varies from three to, at least, 15. BT actually permit only five attempts at dialling a single telephone number. However, some digital communicators permit more than one number to be dialled. Also, the number of different types of signal that a communicator can separately transmit varies, although this is not of great significance when these devices are used simply to transmit fire and fault signals.

CARE

A3.27 CARE is a system, operated by BT, that is similar in principle to ABC (see paragraph A3.7 to A3.11), except that alarms are transmitted to a remote manned centre other than the fire brigade. At present, this means of connection can be provided by about 10 central station operators.

A3.28 One difference between ABC and CARE, is that, whereas the ABC carrier sender is line powered, with an internal battery that supplies power when the telephone is in use, the power supply for the CARE transmitter, known as a Subscriber's Terminal Unit (STU), is derived from the fire alarm system. Also, the STU can actually be built into a fire alarm control panel, as it is supplied by the fire alarm installer, whereas the ABC carrier sender must be a separate unit as it is installed by BT.

A3.29 The architecture of the transmission system is similar to that of ABC. However, the signalling is somewhat more complex. Two forms of signalling are involved. A continuous monitoring signal, which is of an inaudible frequency, is generated by the STU and recognised by the 'Scanner' (of local processor in ABC). In addition the scanner continually polls each STU, which then responds with alarm status conditions.

A3.30 If the subscriber's line fails, the monitoring current will cease and the scanner immediately polls the STU. If several polls fail to result in any response, a fault warning results and this is transmitted via the 'Host' (of the ABC central processor) to the appropriate central station.

A3.31 In the event of an alarm condition, the monitoring signal also ceases, again resulting in an immediate poll by the scanner, which receives a response from the STU indicating the type of alarm signal. Up to eight different types of alarm may be transmitted.

A3.32 No polling occurs when the telephone is off the hook, as audible tones are involved. However, if the monitoring signal stops when the telephone is in use, polling will occur and any alarm signal will be transmitted, the audible tones being heard by the user.

A3.33 As with ABC there is an element of duplication in the transmission path, although this does not apply to the exchange line, the STU or the interface between the exchange line and the scanner. The host computer is sited in a secure bunker and the private circuits to the host are arranged by the central stations. These circuits are normally duplicated and terminated at duplicate display terminals in the central station.

Use of Ambulance Radio Networks

A3.34 Some ambulance services which use selective calling and status signalling radio systems allow one of their mobile radio channels to be used for the transmission of fire alarm signals from health service premises. Typically, each protected premises requires a mobile radio base station with mains power unit, battery and charger and antenna installation.

A3.35 The radio is connected to changeover contacts at the fire alarm panel. In the event of an alarm condition, the change of state of these contacts causes the radio to transmit a signal which initiates an appropriate display on the control equipment in the Ambulance Control Room. The signal is repeated at pre-determined intervals until either an acknowledgement is transmitted from the Ambulance Control or the fire alarm system is reset.

A3.36 This type of system can provide an economic method of alarm transmission that is likely to prove more reliable than systems that use the PSTN, at a cost that is likely to be significantly less than systems which necessitate the rental of dedicated lines. Guidance on the design of such systems is in the course of preparation but, at present, any systems should be designed in accordance with these principles.

Recommended Design Guidelines for Radio Networks

A3.37 These recommendations are intended to apply to any new schemes for monitoring fire alarm signals over mobile radio channels. However, some of the recommendations could be used as a basis for improvements to existing schemes:-

1. Although radio is considered to be a suitable medium for the transmission of fire alarm signals, dedicated channels should ideally be used. These could comprise licensed UHF telemetry frequencies or NHS channels that are, as far as the area in question is concerned, redundant or unused.

2. However, the use of existing mobile radio channels is considered to be acceptable, but it is recommended that only channels with light radio traffic are used, particularly if the traffic involves primarily speech communication. It is not possible to further quantify the term 'light', but the danger of delays or failures in the receipt of fire

alarm signals due to clash of signals on a busy channel must be stressed. It will be necessary to carefully consider each case on its merits and consider the reliability of radio in comparison with the reliability of other viable methods of transmission.

3. To ensure reliability of transmission, installation design should take into account the possibility of radio signal fading, diffraction, refraction and blockage.

4. To ensure reliability only new radios should be installed at protected premises.

5. When an alarm is initiated at protected premises, the radio transmitter should 'latch' and thereafter continue to transmit an alarm signal at pre-determined intervals until an acknowledging signal is received from ambulance control, regardless of the state of the fire alarm system.

6. The interval between repeat transmissions should be in the region of 5-10 seconds.

7. Power supplies for base station radios at the protected premises should comply with the requirements of chapter 8 of this HTM which requires the provision of a normal mains supply with stand-by batteries. The capacity of the batteries should be sufficient to maintain the radio equipment in the standby condition for the requisite period defined in chapter 8 and thereafter be capable of transmitting 15 consecutive alarm transmissions at the pre-determined intervals described in A3.35 and above without any corruption of the transmitted signal.

8. All base stations that form part of the alarm path should comply with (7) above. A fault warning should be transmitted to the ambulance control in the event of failure of the mains supply to base station equipment.

9. The Effective Radiated Power (ERP) of any installation should be the maximum permitted by the DTI. A directional antenna is normally a necessary requirement for a base station of a mobile radio system, but it is important that, in order to obviate very critical angular dependency, no antenna should be highly directional.

10. All antenna feeders should be effectively secured throughout their length and protected from the effects of fire and mechanical damage where they are run within buildings. Consideration should be given to the possibility of monitoring antenna feeders by means of a very small d.c. current (see also recommendation 18 below).

11. Antenna cables and power supply cables should be treated as the wiring of Category 3 circuits, as defined by the current edition of the Institution of Electrical Engineers' Regulations for Electrical Installations, and should be segregated from the cables of other circuits unless, as in the case of power supply cables, mineral insulated cables are used. Close over current protection of power supply cables should be avoided. Moreover, circuits supplying the radios should not be protected with residual current devices (RCDs). Use of, for example, plug and socket arrangements for connection to the mains supply should be avoided. Unswitched spur connections are desirable.

12. It is recommended that consideration be given to the use of the multi-state condition transmitters that are capable of transmitting separately. Obvious uses are Fire, Test and Fault. However, additional states such as an intruder alarm condition or a personal attack alarm could also be relayed to ambulance control, so enhancing the cost effectiveness of an installation. Where, however, a transmitter is manually switched into, say, a test mode, it is recommended that a visual, and if possible an audible, indication be maintained until the transmitter is switched back into the normal mode. Additional facilities should be carefully interfaced with the radio system so that its reliability is not impaired.

13. In certain hospitals, the possible advantages in utilising the speech communication facility between the hospital and the ambulance control should be considered at the design stage. These include the establishment of direct communication at the time of any test and the provision of a verbal assurance that the brigade have been summoned, so possibly obviating the need for staff to make a further call to the brigade. Persons using the speech communication facilities should be adequately trained in correct radio operating procedures.

14. Where possible, location identities should be displayed at ambulance control in the form of clear English text. The use of, for example, card index systems is undesirable.

15. Facilities should be provided to enable ambulance control operators to undertake a test of the communications path to any protected premises by transmitting a radio signal that results in an acknowledgement signal from the protected premises.

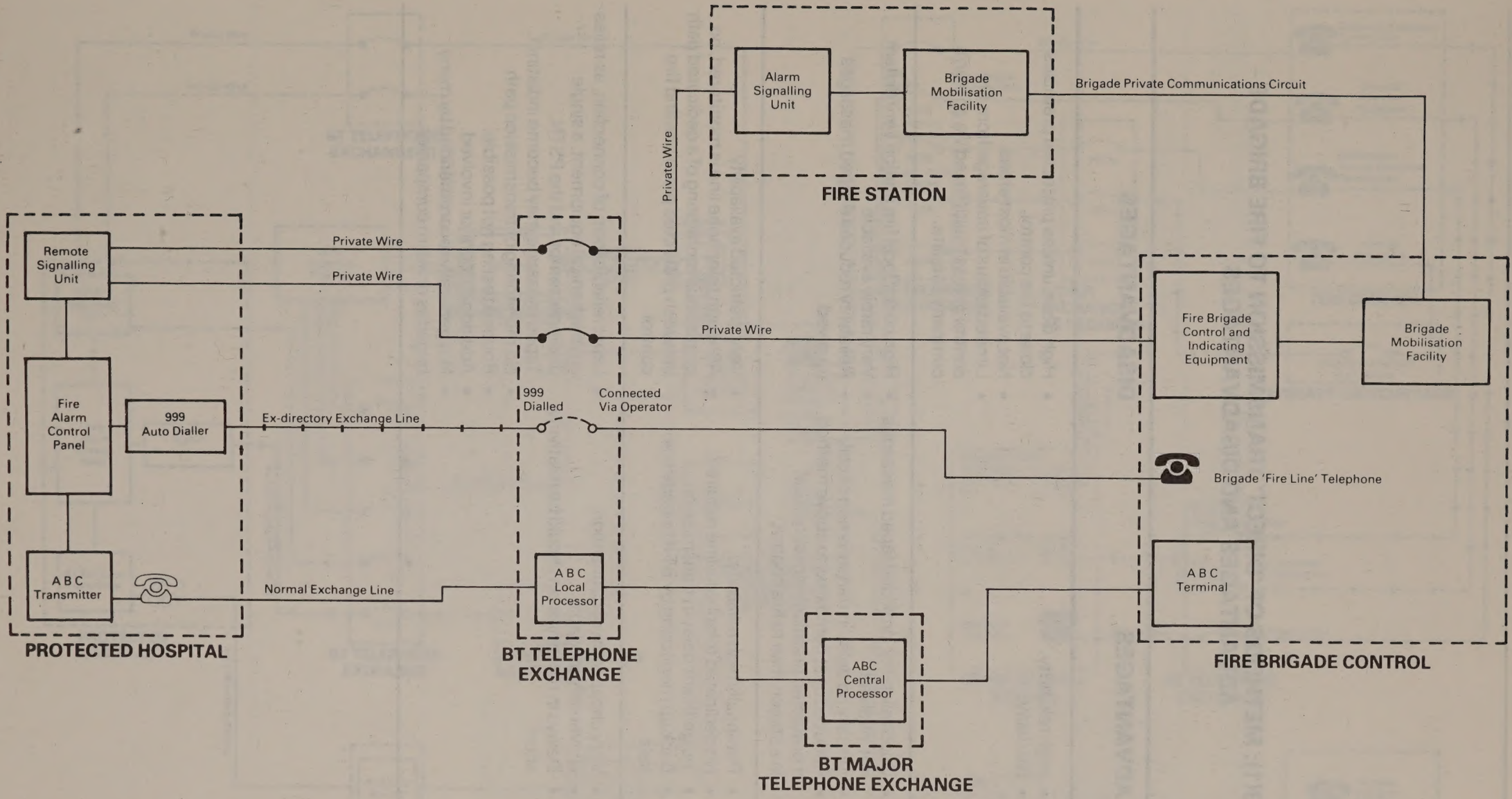
16. Consideration should be given to the automation of the above test by the use of regular,

automatically generated 'interrogation and respond' signals. After failure of a pre-determined number of communication attempts within a specified time period, a fault indication should be displayed at the ambulance control and/or the protected premises.

17. Where diverse routing of radio signals is possible from any protected premises, by virtue of a communications path to more than one base station, advantage should be taken of this possibility.

18. To prove the overall effectiveness of the transmission system a test call should be made daily from the protected premises to the control centre.

19. There should be no possibility of fire alarm signals being patched into the PSTN.



Not acceptable

Fig. A3(1) Means of Connection between protected Hospital and Fire Brigade Control Room.

TABLE A3(1): METHODS OF 'DIRECT' TRANSMISSION TO FIRE BRIGADE - ADVANTAGES AND DISADVANTAGES

METHOD OF CONNECTION	ADVANTAGES	DISADVANTAGES
DIRECT LINE TO BRIGADE CONTROL	★ High reliability. ★ No delay.	★ High Cost, unless protected premises close to fire control. ★ Not available in most areas. ★ Limited radius of coverage from fire control unless multiplexed via an alarm company satellite.
CONNECTION TO BRIGADE CONTROL VIA BRIGADE MOBILISATION SCHEME	★ Good reliability, provided taped messages not involved. ★ Virtually no delay in transmission of call. ★ Reduced cost compared to above method if protected premises closer to local fire station than to fire control.	★ High cost if local fire station very distant. ★ Very rarely available. ★ Reliability reduced if taped messages involved.
ALARMS BY CARRIER (ABC)	★ Potentially high reliability. ★ No dedicated telephone line required. ★ Insignificant delay in transmission. ★ Back up monitoring by BT if brigade link fails.	★ Very restricted availability. ★ Although telephone line is monitored, no continuous monitoring of a dedicated path between protected premises and fire control.
999 AUTODIALLERS	★ Very cheap form of connection. ★ Universally available. ★ Delays in transmission should be relatively short.	★ Least reliable form of connection, as relies on mechanical equipment, a single dialling attempt and the PSTN. ★ Taped message may become indistinct. ★ No monitoring of transmission path. ★ Routine testing not possible. ★ Additional operator involved. ★ Not generally recommended by many brigades or alarm companies.

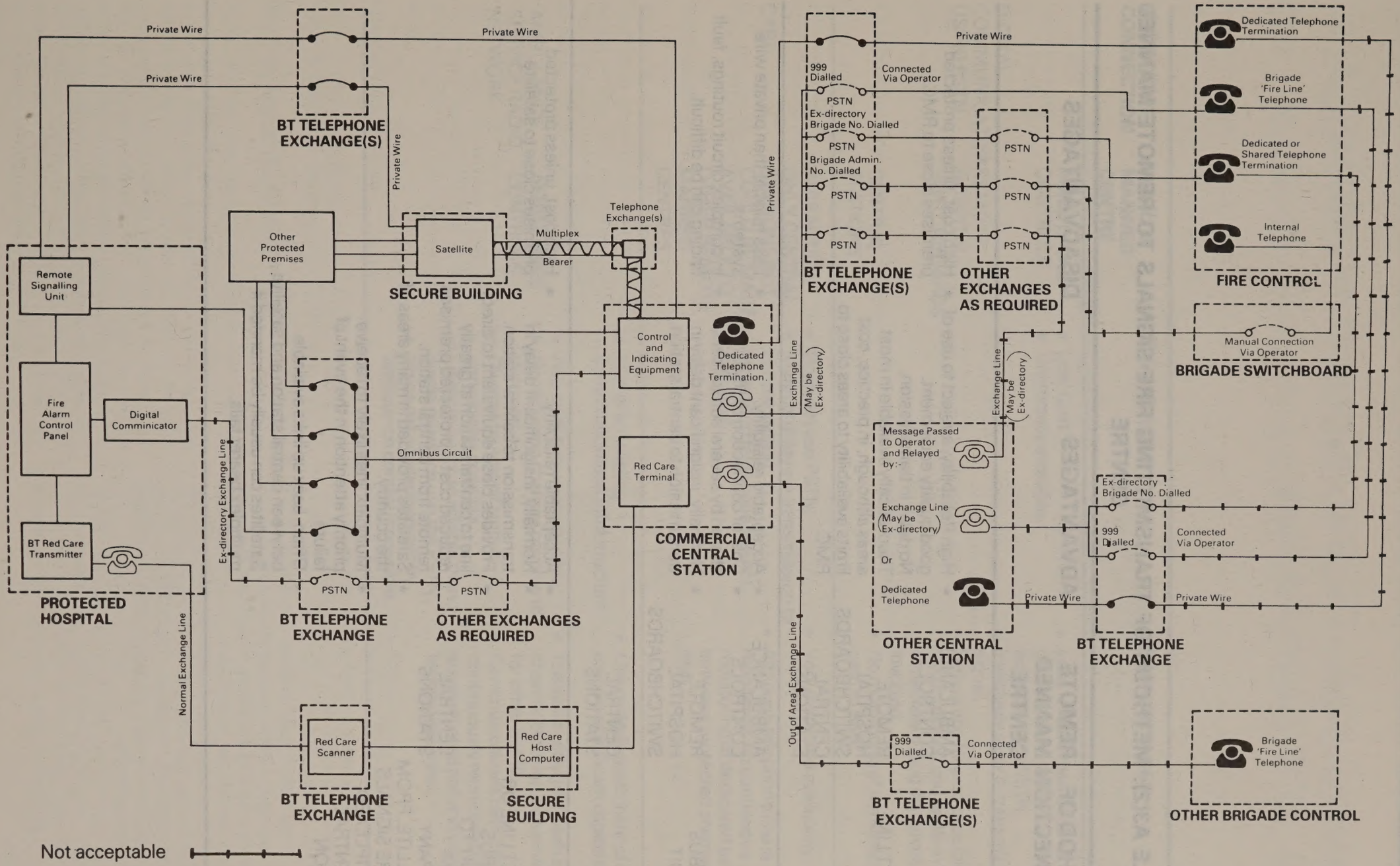


Fig. A3(2) Means of connection between protected Hospital and Fire Brigade Control Room via Commercial Central Station.

TABLE A3(2): METHODS OF TRANSMITTING FIRE SIGNALS TO REMOTE MANNED CENTRE

METHOD OF CONNECTION	REMOTE MANNED CENTRE	ADVANTAGES	DISADVANTAGES
DIRECT LINE	AMBULANCE CONTROLS REMOTE HOSPITAL SWITCHBOARDS CENTRAL STATIONS	★ High Reliability, subject to use of good quality equipment. ★ No delay in transmission. ★ Theoretically available in most areas although, in practice, cost limits availability to areas close to RMC.	★ High cost, unless protected premises close to RMC.
OMNIBUS CIRCUIT	AMBULANCE CONTROLS REMOTE HOSPITAL SWITCHBOARDS CENTRAL STATIONS	★ Acceptable reliability. ★ Cost of connection to RMC shared by several subscribers. ★ Normally, insignificant delay in transmission to central station.	★ Less reliable than private wire systems. ★ In complex circuit routings, fault finding can be difficult.
DIRECT LINE OR OMNIBUS CIRCUIT TO ALARM COMPANY SATELLITE, FROM WHERE SIGNALS MULTIPLEXED TO CENTRAL STATION	CENTRAL STATIONS	★ Acceptable reliability. ★ Normally, insignificant delay in transmission to central station. ★ Provides close equivalent to direct line to central station at greatly reduced cost if protected premises remote from central station. ★ Satellites provided in many areas of the country. ★ Multiplex lines likely to receive priority attention in the event of failure. ★ Often, back up links available between central station and satellite. Satellites can usually be manned if multiplex bearer fails.	★ High cost, unless protected premises close to satellite.

METHOD OF CONNECTION	REMOTE MANNED CENTRE	ADVANTAGES	DISADVANTAGES
DIGITAL COMMUNICATOR USING PSTN	AMBULANCE CONTROLS REMOTE HOSPITAL SWITCHBOARDS CENTRAL STATIONS	★ Low Cost. ★ Universally available.	★ Less reliable than all other methods of connection to a RMC because uses PSTN. ★ Relatively slow in transmission of signal. ★ Delays and failures possible due to congestion and faults in PSTN, especially if long distances involved ★ No monitoring of transmission path to RMC.
CARE	IN PRACTICE, ONLY CENTRAL STATIONS BUT COULD BE MADE AVAILABLE TO OTHER REMOTE MANNED CENTRES	★ Does not use PSTN. ★ Minimal delays in transmission to central station. ★ Dedicated telephone line not essential.	★ Very restricted availability. ★ Although telephone line is monitored, no continuous monitoring of dedicated path between protected premises and RMC.
AMBULANCE SERVICE RADIO NETWORK	AMBULANCE CONTROLS	★ Use of an existing communications infrastructure. ★ Rapid transmission possible. ★ No recurring charges payable to third parties. ★ Diverse routing of signals sometimes possible. ★ Likely to be more reliable than systems which use the PSTN. ★ Voice acknowledgement by ambulance control is possible.	★ Use of dedicated channel could involve significant capital costs. ★ Possibility of signal clash and channel blocking if channels used for other traffic. ★ Communications path not continuously monitored unless sophisticated poll and respond techniques used.

Appendix 3A Digital Communicators and 999 Autodiallers

A3A.1 Digital communicators and 999 autodiallers may be considered in the following circumstances, but the disadvantages of these devices must be borne in mind and other methods are to be preferred.

a. As an additional method of communication in circumstances in which a secondary method of communication is not deemed necessary.

b. As a secondary method of communication in circumstances in which the primary method of communication deviates only marginally from that described in paragraph 3.5a.

c. As a partially redundant system used in combination with another method of communication (such as a 999 auto-dialler and a digital communicator used together), in circumstances where more reliable methods of communication are impracticable.

d. In the case of digital communicators, in circumstances where only local, as opposed to trunk, switching in the PSTN is involved and, by consultation with the central station operating company and the relevant telecommunications operator it can be established that the parameters described in paragraph 3.17 will be satisfied.

A3A.2 The device should be installed on a dedicated 'incoming calls barred' line that is used for no other purpose, and, in the case of a digital communicator, the following should apply.

a. The telephone line should be monitored so that, in the event of failure of the line, an audible and visual warning is given at the protected premises.

b. The digital communicator should be capable of dialling at least two separate telephone numbers a total of eight times. Consideration should be given to the possibility of an arrangement whereby the two numbers relate to two alternative remote manned centres, with which communications by means of the PSTN would be established by substantially different routings within the PSTN.

Appendix 4 Acoustic Recommendations for Audible Fire Alarms in Patient Areas.

General

A4.1 This Appendix is intended to assist in designing an audible warning system for patient areas which provides a signal loud enough to be clearly audible, but not so loud that it will cause unnecessary distress or disturbance to the occupants. The sound level recommendations in this Appendix cannot be expected to rouse sleeping persons and are therefore applicable only in those patient areas where alert staff are in constant attendance.

Fire Alarm Sounder Frequency

A4.2 The fire alarm sounder frequency should lie in the range 500 to 1000 Hz. If a two-tone alarm is used, at least one of the major frequencies should lie within this range.

Fire Alarm Sounder Noise Levels

The Notional Level

A4.3 An environmental noise can be defined by a noise level which is exceeded for 10 per cent of some period of time. This level is termed the L_{10} and is commonly used to describe health building acoustic environments. It is measured in 'A' weighted decibels (dBA). This period may be 1 hour, 12 hours, duration of a clinic, or some other period of time which adequately describes the acoustic environment. For the purpose of these recommendations let the L_{10} during the noisiest period, which will normally be the daytime in wards and day clinics, be termed the notional level.

Minimum Sound Level

A4.4 A fire alarm should be at least 5 dBA above the notional level to be clearly audible 24 hours a day.

New Hospital Buildings

A4.5 The acoustic conditions inside a new hospital building should be a factor in the design. The Department of Health gives guidance on noise levels and recommends L_{10} noise levels for various hospital areas which should not be exceeded, (see paragraph A4.10). The recommended L_{10} levels can be used as notional levels to guide the fire alarm system designer in setting the sounder levels necessary in each area of the building. In other instances where recommended levels do not exist for specified areas, reference can be made to existing buildings to predict the acoustic climate.

Existing Hospital Buildings

A4.6 The noise level in existing hospitals may be higher than the levels recommended in paragraph A4.10. Before installing a new fire alarm system, or when assessing the acoustic performance of an installation, the pertaining notional level in each area served by the alarm should be determined. This can be done either by direct statistical measurement, or more readily, but less accurately estimated from spot sound level meter readings.

Tonal Noise Level

A4.7 Where audible fire alarms are used, the noise level in 'A' weighted decibels (dBA) produced by the fire alarm in an area is termed the tonal noise level. A fire alarm sounder will normally emit a constant high level of sound in a narrow frequency band. Measurement of the tonal noise level in an area can be made by taking spot readings with a sound level meter.

Maximum Tonal Noise Level

A4.8 Verbal communication is important in a ward area where patients may need reassurance or instructions from staff. With a tonal noise level of about 60 dBA conversations will be relaxed and telephone use satisfactory. Telephone use will be difficult if the tonal noise level is 75 dBA or more. The aim should be to restrict the tonal noise level to 15 dBA above the notional level. It may not be reasonably practicable to prevent the tonal noise level exceeding this limit in some spaces in order to achieve the minimum sound level in others.

Siting a Fire Alarm Sounder

A4.9 Sounders should be sited so that adequate noise levels are obtained in each area served by the alarm system. A large number of quieter sounders, rather than a few very loud sounders, will be necessary to prevent noise levels in some areas becoming too loud. In siting sounders in corridors to serve surrounding rooms, account must be taken of the attenuation at the sounder frequency of any dividing elements. It is unlikely that sounder noise levels in a room will be satisfactory if more than one dividing wall, or door, separates it from the nearest sounder. In particular, fire doors are solidly constructed and consequently do not readily transmit sound. Useful guidance is to be found in BSRIA Application Guide 1/81 'Locating Fire Alarm Sounders for Audibility'.

List of Recommended Maximum Notional Levels for Various Areas

A4.10 The following list of recommended maximum noise levels is an extract from DH Health Notice HN(76)126. It does not include spaces which are not sensitive to noise, such as television rooms and kitchens.

i. The noise levels specified in current DH Building Notes, Technical Memoranda and Design Guides which have been brought up-to-date since 1972.

ii. Large committee rooms, lecture theatres: 35 dBA.

iii. Private offices, small committe rooms, seminar rooms, libraries: 40 dBA.

iv. Wards: 40 to 45 dBA.

v. Medium-sized offices, laboratories where no machines are used, bedrooms of staff residences: 45 dBA.

vi. Operating theatres and treatment rooms: 45 - 55 dBA.

vii. Out-patient areas: 50 dBA where conversations are held. In some diagnostic areas a lower noise level is desirable.

viii. General offices, laboratories, dining areas: 55 dBA.

ix. Typing Pools: 60 dBA.

x. General waiting areas: 60 dBA.

xi. Industrial areas: maximum 85 dBA.

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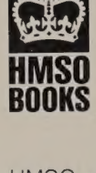

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